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ON THE DETERMINANTS OF CORPORATE HEDGING WITH FINANCIAL DERIVATIVES

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On the Determinants of Corporate Hedging with Derivatives
Abstract

We examine explanations for corporate policy choices related to the use of derivative financial instruments. Recent corporate disclosure requirements allows us to replicate and extend the work of Nance, Smith, and Smithson (1993, NSS) using a larger sample. We extend previous research by considering interest rate and foreign exchange hedging separately, using continuous rather than binary measures of hedging, and including variables measuring level of multinationality and exposure to interest rate and foreign exchange rate changes. The findings document robust empirical relationships among corporate policy decisions and firm characteristics. In a tobit regression analysis, our results suggest that firms which use more derivatives are more multinational, less liquid, more subject to progressive taxation, less subject to regulation, and larger. They have more growth opportunities, and issue less debt substitutes. Thus, firms appear to hedge to reduce exposure to foreign exchange risk created by foreign operations, to reduce conflicts between bondholders and shareholders, and to reduce the higher default risk associated with lower liquidity. Contrary to expectation, hedging is associated with lower dividend payouts, possibly due to the correlation of dividend payout with growth opportunities. Overall, this study confirms the findings of NSS that the determinants of derivative usage are risk reducing hedges.

Our conditional results are stronger for hedgers of foreign exchange risk exposure than for hedgers of interest rate risk exposure. One possible explanation is that there is a difference in the level of hedging achieved by the use of the different derivatives. Foreign exchange derivatives hedge the exposure created by foreign investments and foreign currency transactions. Objectives for using interest rate derivatives are more ambiguous. As indicated in the notes to financial statements, interest rate derivatives are used to modify the debt structure and thus the capital structure of firms. It is likely that interest rate derivatives are motivated by arbitrage opportunities created by capital market imperfections and transaction cost differences in addition to hedging interest rate exposure.

Introduction

Usage of financial derivatives has increased significantly in recent years. Dolde (1993) reports that "between 1986 and 1991, the volume of exchange-traded and over -the-counter (OTC) derivatives increased at an annual rate of 48%, from $1.4 trillion to $9.8 trillion." This study gathers data from recently mandated derivatives disclosures to determine if there are robust empirical relationships among corporate hedging policy decisions and various firm characteristics.

Previous research, particularly Nance, Smith, and Smithson (1993, NSS), investigated the determinants of corporate hedging but is limited by availability of data. SFAS 105 (FASB 1990) requires firms to disclose the contract or notional principal[1] amount of off-balance-sheet financial instruments with risk of accounting loss outstanding at the balance sheet date. The disclosures provide a measure of use of financial derivatives. Utilizing these disclosures, this paper provides additional evidence on the determinants of corporate hedging with the use of interest rate (IR) and exchange rate (FX) derivatives. Consistent with the recommendations of NSS we extend their study and increase the power of their research in several ways. First, we use recently mandated disclosures and are thus able to draw a sample of 438 firms as compared to NSS sample of 169 firms. Second, we disaggregate hedging instruments into foreign-exchange and interest-rate derivatives. Third, we use continuous measures of hedging activity, notional amounts of each type of derivative and total derivatives divided by market value of the firm rather than binary dependent variables. Fourth, we identify additional explanatory variables which include level of multinationality, and

[1]The notional principal amount is a reference amount. In an interest rate swap the notional principal amount of the contract is not exchanged. It is the basis upon which interest payments are calculated.

regression coefficients that measure exposure to exchange rate and interest rate changes. Fifth and finally, we use a tobit analysis that considers not only whether or not a firm hedges but also the magnitude of the hedging to measure associations among the variables.

Firms implement hedging by policies that use various financial instruments (or operational strategies) to reduce risk of cash flows or earnings due to unexpected interest-rate or exchange-rate changes. However, similar to NSS, we define hedging as use of off-balance-sheet instruments (i.e., derivatives) such as interest rate or foreign exchange forwards, futures, swaps and options, to reduce the volatility of firm value.

NSS interpret the results of a logit analysis as supporting the premise that firms which hedge face more convex tax functions, have less coverage of fixed claims, are larger, have more growth options in their investment opportunity set, and employ fewer hedging substitutes. Overall, the evidence developed in this study confirms their findings.

Using a tobit analysis, we find, consistent with NSS, that both IR and FX hedgers face convex tax functions, have more growth options in their investment opportunity set, and are less liquid, and larger than non-hedgers. In addition, IR hedgers are more highly leveraged, employ fewer debt substitutes and are measurably exposed to interest-rate risk. Additionally, FX hedgers are more multinational. Also, regulated firms hedge less than non-regulated firms. The findings support use of derivatives as a hedge to reduce debtholder-shareholder conflict, costs of financial distress, taxes and risks associated with foreign investments and interest rate changes. The results are also consistent with the existence of informational and transactional economies of scale. Contrary to our expectation, we find FX hedging associated with lower dividend payouts. This finding is likely a result of an inverse association between

growth opportunities and dividend payout.

We find less robust results associated with interest-rate hedging than for foreign exchange hedging. Our results are consistent interest-rate hedging being used to arbitrage imperfections in markets to optimize debt structure.

In Section I, we discuss previous research which is the background for this study. Dependent variables reflecting firms' hedging policy are described in Section II. Independent variables we expect to explain hedging activity are described in Section III. In Section IV, we describe our data, present univariate test results indicating differences between hedgers and non-hedgers, present results from estimating tobit models explaining IR, FX, and total hedging, and compare our results to NSS. Section VI. concludes.

I. Background

Nance, Smith, and Smithson (1993, NSS) provide evidence about the characteristics associated with firms use of derivatives from a survey of 169 useable responses. They argue risk aversion provides an unsatisfactory explanation for the observed volume of hedging since derivatives markets are dominated by corporations and institutions and not individuals trading for their personal accounts. Portfolio theory implies that, given well-diversified investors, corporate hedging does not benefit shareholders by reducing the firm's cost of capital. Based largely on Smith and Stulz (1985), NSS argue that financial economics offers several hypotheses to explain corporate use of derivatives. Much of our discussion and development of independent variables is taken from NSS. They compare the mean values of their explanatory variables between hedgers and non-hedgers. They also use a logistic regression

analysis to provide evidence on conditional relationships. Their results are compared with our results later.

Smith and Stulz (1985) develop a positive theory of the hedging behavior of value-maximizing corporations. They argue that hedging policy affects the value of the firm through taxes, contracting costs, or the impact of hedging on the firm's investment decisions. We summarize their theory development as we discuss our independent variables. Smith and Watts (1992) model the cross-sectional variation in corporate policies. They argue that firm-specific investments result in variation in firms' investment opportunity sets. Additionally, financial policies and regulation varies across firms.

Although all corporate policy choices are endogenously determined, we assume, consistent with NSS, Smith and Watts (1992), and Gaver and Gaver (1993), that financial and investment policies are determined prior to decisions on the use of financial derivatives. We also note that regulation and tax policy are determined within the political process, and there exists innovation in both the real investment activities of firms as well as the contracts they employ. Our statistical analysis, however, requires only that these factors be predetermined, not that they be completely exogenous. Thus, we take the firm's investment and on-balance-sheet financing strategies as predetermined and focus on off-balance-sheet hedging.

II. Hedging Policy - Dependent Variables

We construct three continuous dependent variables. The variables are the ratios of notional amount of interest rate, foreign exchange rate, and total derivatives to VALUE (market value of the firm). VALUE equals the sum of the market value of equity, and book

values of preferred stock and liabilities. We do not consider commodity derivatives in this study. We construct the variables as follows[2] :

IRDERIV = (Notional amount of interest rate derivatives) / VALUE

FXDERIV = (Notional amount of foreign exchange derivatives) / VALUE

TOTDERIV = (Total notional amount of both IR and FX derivatives) / VALUE[3]

III. Hedging Determinants - Independent Variables

We identify variables representing the investment opportunity set, financing decisions, regulation, and taxation. To maintain comparability with NSS, we use the same variables but consider six additional variables identified in the hedging literature: interest rate exposure, exchange rate exposure, multinationality, export sales, credit rating, and regulation. First we develop the NSS variables followed by the additional variables. The Appendix contains variable definitions with reference to COMPUSTAT item numbers where appropriate.

Taxes.

Smith and Stulz (1985) argue if marginal tax rates are progressive (i.e., the effective tax schedule is convex) expected taxes are reduced and firm value raised by hedging. The convex region is extended by tax preference items such as tax loss carryforwards and

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[2]Occasionally, firms enter into offsetting contracts such as an interest rate swap converting fixed rate to variable rate payments to neutralize the effect of an earlier swap that converted variable rate debt to fixed rate debt. Based on the annual reports reviewed to establish the data base for this study, the authors conclude that this situation is rare, and difficult to quantify. Therefore, we do not expect including total reported swaps to produce misleading results.

[3] If a firm reported only a combined total of foreign exchange and interest rate derivatives, we did not include the amounts in the separate categories but did include the amounts in total derivatives. Therefore, TOTDERIV exceeds the sum of IRDERIV and FXDERIV for 11 firms (2.5%) in our sample.

investment tax credits that offset part of a corporation's tax liability. Although, the progressive range in U.S. corporate tax rates is relatively small, firms with more pretax income in the progressive range have greater incentive to hedge. Pretax income is considered in the progressive range and PROGRESSIVE equals 1 if any part of a 95% confidence interval (based on the variance of pretax income over the prior ten years) around 1993 pretax income is $0 - $75,000, otherwise PROGRESSIVE equals 0.[4] TAXLOSSCF equals tax loss carryforwards available in 1993. ITC equals investment tax credits used to offset corporate income tax payable in 1993.[5]

Growth opportunities.

Myers (1977) characterizes firms' potential investment opportunities as options and demonstrates that, with fixed claims in the capital structure, taking a positive net present value (NPV) project in certain states reduces shareholders' wealth. Consequently, shareholders have incentive to forego some positive NPV projects. Hedging can help control this problem by restricting the states in which the firm would default on bond payments. Hence, firms with more growth options in their investment opportunity set are more likely to undertake a hedging program aimed at reducing variance in value. We use two measures of growth opportunities. The ratio of book value of assets to firm market value (BOOK/VALUE) is the first measure of growth opportunities. The second measure is the ratio of Research and Development expenditures to the value of the firm (R&D/VALUE).

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[4]Due to changes in the tax laws since the NSS study, we use a range of $0-$75,000 instead of $0-$100,000.

[5]Due to tax law changes, the investments that qualify and therefore amounts of ITC are less than in NSS.

We expect a positive association between hedging and R&D/VALUE and a negative association between hedging and BOOK/VALUE.

Financing policy.

There are several reasons to expect firms with higher levels of debt to use more derivatives. First, interest rate contracts are frequently used as a low cost means to adjust debt to a preferred maturity or basis (fixed or floating). Firms which use more debt are expected to adjust debt characteristics more frequently with interest rate derivatives. Second, more highly leveraged firms have greater exposure to financial distress and thus more incentive to manage risk with derivatives. Third, the underinvestment problem is more pronounced with more debt in the firm's capital structure. Thus, firms with higher leverage are more likely to hedge.[6]

We construct two variables to measure leverage. LTDEBT/VALUE is the average three year (1991-1993) ratio of the book value of long term debt to VALUE. Coverage of fixed claims is the ratio of the three-year (1991-1993) average of earnings before interest and taxes to the three-year average of total interest expense (EBIT/INTEREST).

Convertible debt and preferred stock can be viewed as substitutes for hedging because they help prevent agency problems. Convertible debt includes an imbedded option which makes this liability more sensitive to firm value changes and thereby reduces the sensitivity of equity value to firm value changes. Default on interest payments can lead to bankruptcy.

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[6] An alternative means of reducing the conflict between bondholder and shareholder is to reduce the debt in the capital structure. However, reducing debt reduces debt related tax shields. Thus, not reducing debt but reducing the conflict between shareholders and bondholders through the use of hedging could be a lower cost alternative.

Since preferred stock dividends can be deferred, the likelihood of financial distress is reduced. Therefore, we construct two additional variables to measure debt substitution. They are the ratio of the book value of convertible debt to firm value (CONVDEBT/VALUE) and the ratio of the book value of preferred stock to firm value (PFDSTK/VALUE).

Firms can also reduce the probability of default by reducing the dividend payout or by investing in more liquid assets. Therefore, we construct LIQUIDITY, the 1991 to 1993 average ratio of current assets to current liabilities (i.e., the current ratio), and DIVYIELD, the 1991 to 1993 average of the dividend-price ratio.

Firm size.

Size is measured by the book value of debt and preferred stock plus market value of common equity (VALUE). NSS provide several reasons why firm size affects hedging activity. Some reasons indicate small firms are more likely to hedge, while others indicate the opposite. Direct costs of financial distress (i.e., bankruptcy) are less than proportional to firm size, making it more likely small firms hedge. Smaller firms are more likely to have income in the progressive region of the tax schedule, again implying smaller firms are more likely to hedge. On the other hand, hedging programs exhibit informational scale economies. Larger firms can employ managers with the specialized information to manage a hedging program employing derivative instruments. Also, derivative markets exhibit significant scale economies in the structure of transactions costs, which makes hedging more attractive for large firms. Ultimately, the relationship between use of derivatives and size is an empirical question.

Multinationality.

Goldberg, Tritschler, and Godwin (1994, GTG) report firm disclosures indicate that foreign exchange derivatives are used to hedge foreign investments as well as exports and other inter-currency transactions. The ratio of foreign sales[7] to firm value (FS/VALUE) proxies for multinationality. [8] The ratio of exports to firm value (EXPORT/VALUE) measures the level of export activity.

Exchange rate exposure.

Firms report foreign exchange derivatives are used to hedge exposure to foreign exchange risk (GTG). Adler and Dumas (1984) define exchange rate exposure as the sensitivity of asset values to random variations in the future domestic purchasing powers of foreign currencies. They argue that the regression coefficient of stock returns on exchange rate changes is a measure of exchange rate exposure. We follow Jorion (1990) and measure exchange rate exposure (FXEXPOSURE) as the absolute value of the coefficient from a regression of monthly stock returns on the change in weighted average exchange rate (International Financial Statistics Series NEU) for the period 1985 through 1992.[9] The sign of the coefficient on FXEXPOSURE, indicates whether a long or a short position in a

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[7]Foreign sales and exports are taken from SFAS 14 (FASB 1976) disclosures. Therefore, foreign sales are sales of foreign based operations to unaffiliated customers. Exports are sales from domestic operations to unaffiliated foreign customers.

[8]Jorion (1990) uses the ratio of foreign to total sales as a measure of multinationality. Similar to other variables in this study, we standardize using value of the firm (VALUE).

[9]It is impossible to empirically identify exposure to exchange rate (or interest rate) changes before considering the effects of hedging activity. Therefore, FXEXPOSURE and IREXPOSURE measure exposure net of the effect of derivatives.

currency neutralizes exposure. Long and short positions are reflected identically however, in our dependent variable, FXDERIV. Therefore, we ignore the direction of coefficient of exposure and use the absolute value.

Interest rate exposure.

Dolde (1993) concludes that "some current variations in corporate practice [in use of derivatives] reflect important differences among firms in their degree of exposure to financial risks ...." We expect the more sensitive a firm's value is to changes in interest rates the greater the use of derivatives for hedging. We construct the variable in a manner similar to Choi, et al. (1992) and Sweeney and Warga (1984). IREXPOSURE is the absolute value of the coefficient from a regression of monthly stock returns on the changes in the 3 month treasury bill interest-rate for the period 1985 to 1992 .

Credit rating.

Wall and Pringle (1989) review motivations for entering into swaps. Arbitrage of quality spread differentials (i.e., the differences in interest rates paid by firms due to differences in credit quality), may result in lower rated firms finding a combination of short-term debt and interest rate swaps to have lower agency costs than long-term debt. They provide evidence that firms with rated debt use swaps in a manner consistent with an arbitrage and agency cost explanation and lower rated firms are more likely to hedge to reduce the costs of financial distress. However, annual reports of major derivative-dealer banks indicate restrictive credit controls are applied in derivative activities and their credit

loss experience has been low. Thus, it appears credit worthiness is a factor in accessing derivative markets. Given competing factors, our expectation of direction of association is indeterminate. CREDITRAT is determined by the S&P rating in COMPUSTAT. Lower numbers in the scale from 2 to 9 reflect higher quality credit.

Regulation.

The nature of certain regulated industries is expected to affect the use of derivatives. Financing decisions of regulated companies must be approved by regulatory commissions which restricts innovation. REGULATION equals 1 if the firm's SIC is 4000-4999 (utilities, transportation, etc.), otherwise zero.

IV. Empirical Evidence

We requested annual reports and 10-Ks from the 1457 firms in the Disclosure data base with book assets greater than $1 billion. We excluded banks and other financial services firms (SIC 6000-6999) from the sample due to their role in the derivatives market as dealers and intermediaries. We obtained financial statements for 517 firms. Of these firms, 449 were in COMPUSTAT. We reduced the sample to 438 because data needed to compute firm value was missing. Other than the exclusion of firms with assets less than $1 billion and of financial companies, there are no known biases in the sample makeup.

We determine types and notional amounts of derivatives from disclosures in 1993 year-end notes to the financial statements and management discussion and analysis. Notional amounts were contained in one or more notes for each firm under a variety of note categories.

Often there was limited description of the contracts.[10] Therefore, we exercised judgement identifying the categories and amounts of derivatives.

Table 1 breaks down the sample by industry (SIC). The last column presents a t-test of differences between the mean of the firms in the indicated SIC and the mean of the remainder of the sample. Firms in the agriculture and mining (SIC 0001-1999) and petroleum (SIC 2911) industries use significantly less interest rate and foreign exchange derivatives than other firms in the sample. Management discussion and analysis in annual reports and notes to the financial statements indicate that firms dealing in exchange traded commodities hedge using commodity related derivatives as opposed to exclusively using the derivatives considered in this study. Firms in the utilities and transportation industries (SIC 4000-4999) use less financial derivatives than other industries due to the restrictive environment in which financing decisions are made.[11]

Table 2 summarizes the type and notional amount of interest rate and foreign exchange derivatives reported by sample companies and reports the ratio of notional amounts to value. Of the 438 firms in the sample, 182 (41.6%) of the firms use interest rate, 170 (38.8%) use FX, and 253 (57.8%) use either or both types of derivatives. This compares with 104 firms (61.5%) of NSS' sample, 244 (85.2%) of Dolde's sample, and 175 (68.4%) of our manufacturing sub-sample.. Neither the NSS nor Dolde studies distinguished between IR and FX derivatives and both samples consisted of larger, Fortune 500, firms. The range of usage

[10]See GTG for a description of the challenges involved with identifying derivative contracts and amounts in financial statement notes.

[11]Utilities and transportation firms hedge using energy derivatives and long-term purchase commitments.

of derivatives is from the maximum total of year-end contracts equal to 131% of the market value of the firm to zero.

Table 3 reports univariate comparisons of firms that use derivatives with those that do not use of derivatives. Columns 5, 6, and 7 contain t-statistics for tests of differences in means between hedgers and non-hedgers that use either or both type derivatives. The results generally support our hypotheses that firms hedge to reduce the costs of financial distress, avoid debtholder-shareholder conflict, reduce taxes, and neutralize the exposure to exchange rate changes. The unconditional tests show, as expected, hedgers have greater growth opportunities (R&D/VALUE), are more multinational (FS/VALUE), use less debt substitutes (PFDSTK/VALUE) and are less liquid (LIQUIDITY) than non-hedgers. Also, as expected, firms in the progressive tax range (PROGRESSIVE) hedge more and regulated firms (REGULATION) hedge less than other firms.

We find no significant difference between hedgers and non-hedgers for BOOK/VALUE for total derivatives. The ratio is smaller for foreign exchange hedgers as expected. Larger firms (VALUE) hedge more than smaller firms. This result supports an hypothesis that larger firms benefit from informational and transactional economies of scale and is contrary to an hypothesis that smaller firms hedging more due to proportionately greater costs of financial distress and higher likelihood of having income in the progressive range. Contrary to expectation dividend payouts are smaller for hedgers than non-hedgers.

We employ three models corresponding to hedging with interest-rate, foreign-exchange, and total derivatives to investigate conditional relationships. Since negative

hedging[12] is unobservable, i.e., non-hedgers have values of zero for the dependent variables, we have a censored regression or tobit model.[13] Parameters are estimated using maximum likelihood estimation.

Table 4, Panels A, B, and C present parameter estimates of the tobit model for each dependent variable: the ratios of interest rate plus foreign exchange (TOTDERIV), interest rate (IRDERIV), and foreign exchange (FXDERIV) derivatives to firm value, respectively. The second column presents estimated parameters for the model consisting of the same independent variables as in NSS. The third column contains parameter estimates using all independent variables. The fourth column presents parameter estimates for a model containing only VALUE and each other independent variable separately.

For total, IR and FX derivatives (Panels A, B, and C), firms which use more derivatives are less liquid (LIQUIDITY), more subject to progressive taxation (PROGRESSIVE), less subject to regulation (REGULATION), larger (VALUE), and have more growth opportunities (R&D/VALUE and BOOK/VALUE). IR hedging is also associated with higher leverage (LTDEBT/VALUE and EBIT/INTEREST) and inversely associated with debt substitution (PFDSTK/VALUE). Overall, our findings are consistent with firms hedging to reduce conflicts between bondholders and shareholders, and to reduce the costs of financial distress.

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[12]To conceptualize negative hedging, envision a world where a model such as ours produces an exact measurement of a firm's level of hedging. The higher the positive number the higher the level of hedging. No hedging takes place if the measurement is zero or lower. The lower the negative number the more the firm's characteristics would have to change before it would hedge.

[13]Greene (1993) discusses the censored regression model or tobit model. The application of tobit in this paper is analogous to Greene's Example 22.9 on pages 695-6.

Due to the construction of PROGRESSIVE, firms with higher variance of earnings will tend to be included in the progressive range. Since higher variance of earnings could lead to financial distress, the positive coefficient may reflect hedging to reduce the costs associated with financial distress.

Contrary to our expectation, hedging is negatively associated with dividend payouts (DIVYIELD). This could be due to the correlation of dividend payout with growth opportunities. FX hedging is associated with lower debt to equity which is possibly related to the positive correlation of both with size.

We find a strong association between multinationality (FS/VALUE) and FX hedging and total hedging. This finding is consistent with hedging FX exposure of foreign operations. Table 3 reports a strong unconditional association also exists between FS/VALUE and IR hedging. One interpretation of our findings is that FX exposure of foreign operations is a strong motivation for hedging. Due to economies of scale of hedging operations and transaction costs, companies that hedge FX are more likely to also hedge IR. The opposite case is also likely, i.e., economies of scale encourage companies that hedge IR to also hedge FX. The correlation coefficient between IRDERIV and FXDERIV is .3633 with a p-value of .0001.

Table 4 Panels A and B show a significant association between IREXPOSURE and both IRDERIV and TOTDERIV suggesting hedging is correlated with interest rate exposure. We do not find significant association between FXEXPOSURE and hedging. Since our measurement of FX exposure is net of hedging, our inability to find significant association could reflect the effectiveness of firm hedging. We also analyze alternative time periods.

The results (not reported) are qualitatively similar to those reported.

Table 5 summarizes our findings and compares them to NSS. Our results are generally more robust across different model specifications than are those of NSS. This is evidently due to pre-SFAS 105 data limitations, and our expanded set of independent variables.. We find less significant association for ITC which could be due to changes in the tax law which reduced availability of investment tax credit since the NSS sample period. The sign of our association for dividend payout ratio is the reverse of NSS. We have no explanation other than the results reflect the difference in time period and sample.

We calculated the log of the likelihood ratio between the models using the NSS variables only and the models including the additional variables (Panels A, B, and C). For the IRDERIV, FXDERIV, and TOTDERIV models, the additional variables significantly increased explanatory power.

V. Summary and Conclusions

The purpose of this paper is to provide additional evidence on the determinants of hedging with derivatives. We find support for firms hedging to reduce (1) exposure to foreign exchange risk created by investments in foreign operations, (2) income taxes, (3) debtholder-shareholder conflicts created by growth opportunities, and (4) costs of financial distress. Our results are also consistent with larger firms hedging proportionately more to benefit from economies of scale. Regulated firms hedge less than non-regulated firms.

Our conditional results hold stronger for hedgers of foreign exchange risk exposure than for hedgers of interest rate risk exposure. One possible explanation is that there is a difference in level of hedging achieved by use of the different derivatives. Foreign exchange

derivatives hedge exposure created by foreign investments and foreign currency transactions. Objectives for using interest rate derivatives are more ambiguous. Notes to financial statements indicate firms use interest rate derivatives to modify debt and thus capital structure of firms. It is likely that interest rate derivatives are motivated by arbitrage opportunities created by perceived capital market imperfections and differential transaction costs among firms. Thus, we distinguish between interest rate derivatives used strictly as a hedge to reduce risk of loss due to interest rate changes (investigated by this paper) and interest rate contracts used to arbitrage capital markets to reduce the net costs of borrowing. In the latter case, the net structure of debt is unchanged by the use of the interest rate contracts. In other words, the term structure and repricing structure of debt is unchanged from what could have been achieved directly in the cash market, however, the use of derivatives synthetically reduces the net cost of borrowing. Therefore, the motivation is to increase profit rather than to reduce the risk of loss due to interest rate changes. Research is underway hypothesizing and testing the use of interest rate derivatives to arbitrage capital market imperfections.

Appendix
Variable Definitions

IRDERIV: Notional amount of interest rate derivatives reported in annual financial statements/ VALUE. (VALUE is defined below.)

FXDERIV: Notional amount of foreign exchange derivatives reported in annual financial statements / VALUE .

TOTDERIV: Total notional amount of both IR and FX derivatives / VALUE.

TAXLOSSCF: Tax Loss Carryforwards available in 1992 (# 52).**

ITC: Investment Tax Credits used in 1993 (# 51).

PROGRESSIVE: 1 if any part of a 95% confidence interval (based on the variance of pretax income in the prior ten years) around 1993 pretax income is $0 - $75,000.
0 otherwise (Pretax Income = #16 + #18).

EBIT/INTEREST: Three year (1991-1993) average Earnings Before Interest and Tax (#178) / Three year (1991-1993) average Interest Expense (#15).

LTDEBT/VALUE: Three year (1991-1993) average ratio of the Book value of Long Term Debt (#9) / VALUE.

VALUE: Book Value of Debt and Preferred Stock (#6 - #60) + Market Value of Common Equity (#199 * #25).

R&D/VALUE: 1993 Research and Development Expenditures (#46) / VALUE.

BOOK/VALUE: Book Value of Assets (#6) / VALUE.

CONVDEBT/VALUE: Book Value of Convertible Debt (#79) / VALUE.

PFDSTK/VALUE: Book Value of Preferred Stock (#130) / VALUE.

LIQUIDITY: 1991 to 1993 average ratio of Current Assets (#4) to Current Liabilities (#5).

DIVYIELD: 1991-1993 average of the Dividend per Share (#201) / Price per Share (#199).

FS/VALUE: 1993 Foreign Sales / VALUE.

EXPORT/VALUE: 1993 Export Sales / VALUE.

FXEXPOSURE: Absolute value of the coefficient of the regression of monthly stock returns on the change in weighted average exchange rate (International Financial Statistics Series NEU) for the period 1985-1992.

IREXPOSURE: Absolute value of the coefficient of the regression of monthly stock returns on the change in 3 month treasury bill interest rate for the period 1985-1992.

CREDITRAT: 1993 S & P Bond Rating available on COMPUSTAT (#280).

REGULATION: 1 if a firm's SIC is between 4000 and 4999,
0 otherwise.

**: # indicates the Annual Industrial Compustat Item #.

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Table 1
Number of Firms and 1993 Median, and Mean Ratio of Notional Amounts of Interest Rate and Foreign Exchange Derivatives[1] to Size[2] by Industry

Industry (SIC)	No. of Firms	Median (Maximum)	Mean (Standard Deviation)	Industry Mean - Sample Mean[3] (t-statistic) [p value]
Agriculture, Mining, etc. (0001-1999)	25	0 (.124)	.019 (.032)	-.034 (-4.11) [.0001]
Manufacturing (2000-3999, excluding 2834, and 2911)	223	.033 (.680)	.064 (.099)	.027 (2.70) [.0071]
Pharmaceutical (2834)	15	.034 (.134)	.050 (.044)	-.001 (.065) [.9485]
Petroleum Refining (2911)	18	.011 (.164)	.026 (.041)	-.026 (-2.38) [.0242]
Total Manufacturing (2000-3999)	256	.032 (.680)	.061 (.094)	.023 (2.23) [.0266]
Utilities, Transportation, etc. (4000-4999)	98	0 (.470)	.034 (.083)	-.022 (-2.15) [.0330]
Retail, Wholesale, etc. (5000-5999)	43	0 (1.31)	.052 (.200)	.001 (.043) [.9657]
Services, etc. (7000-)	16	.035 (.153)	.049 (.050)	-.002 (-.173) [.8645]
Total Sample	438	.013 (1.31)	.051 (.104)	

[1]Derivative descriptions and notional amounts are disclosed in notes to annual financial statements. Size or VALUE is determined using COMPUSTAT.
[2]VALUE consists of market value of common equity plus book value of debt plus book value of preferred stock.
[3]Test of differences of industry mean and the mean of all other firms in the sample.

Table 2
1993 Summary of Reported Notional Amounts of Interest Rate (IR) and Foreign Exchange (FX) Derivatives
Total Sample 438 Firms

Type of Derivative Reported	No. of Firms Reptg Use of Derivatives (% of Sample)	Notional Amounts Reported - $ million (Ratio of Notional Amounts to VALUE)			
		Mean	Median	Minimum	Maximum
IR Swaps	153 (34.9%)	831.76 (0.0618)	250 (0.0376)	7 (0.0012)	36500 (1.0032)
IR Forwards and Futures	13 (3%)	846.03 (0.0662)	246 (0.0323)	30 (0.0043)	4204 (0.4525)
IR options, floors and caps	20 (4.6%)	933 (0.0496)	221 (0.0435)	35 (0.0016)	11139 (0.1095)
IR but not clear or combination of above	16 (1.1%)	2164.94 (0.1068)	959 (0.0705)	20.6 (0.0038)	9302 (0.2884)
Total Interest Rate (IR) Derivatives	182 (41.6%)	1052.51 (0.0715)	250 (0.0389)	7 (0.0012)	36500 (1.0032)
FX swaps	41 (9.4%)	429.97 (0.0199)	122 (0.0121)	15 (0.0011)	8599 (0.0821)
FX forwards and futures	109 (24.9%)	734.23 (0.0479)	191 (0.0306)	4.6 (0.0003)	14397 (0.4592)
FX options	23 (5.3%)	408.86 (0.0333)	131.09 (0.0177)	6.8 (0.0009)	2600 (0.1821)
FX but not clear or combination of above	46 (10.5%)	741.10 (0.0427)	234.3 (0.0219)	6 (0.0015)	8600 (0.3076)
Total For Exch (FX) Derivatives	170 (38.8%)	830.32 (0.0516)	208.25 (0.0347)	4.6 (0.0003)	14397 (0.5058)
Combined FX and IR derivatives	11 (2.5%)	1921.93 (0.05)	346.4 (0.0222)	54 (0.0061)	17244 (0.1809)
Total IR and FX Derivatives	253 (57.8%)	1398.63 (0.0883)	307 (0.0519)	4.6 (0.0018)	45100 (1.3108)

Source: Derivative descriptions and notional amounts are disclosed in notes to annual financial statements.
VALUE determined using COMPUSTAT. Consists of market value of common equity plus book value of debt plus book value of preferred stock.

Table 3
Differences between Hedgers and Non-hedgers
Predicted relationships among the variables and a comparison of the mean values for all sample firms in 1993.

Variables	Predicted sign of Parameter Estimate	Means for all hedgers (IR, FX or both)		T-statistics for differences in means test Hedgers - Non-hedgers (H-NH)		
		Hedgers (n)	Non-hedgers (n)	All hedgers - Non-hedgers	IR hedgers - Non-hedgers	Fx hedgers - Non-hedgers
(1) TAXLOSSCF ($mil)	+	71.08 (253)	25.24 (185)	1.821*	0.272	1.576
(2) ITC ($mil)	+	1.95 (253)	2.19 (185)	-0.271	-0.018	-0.534
(3) PROGRESSIVE	+	0.5 (253)	0.34 (185)	3.404***	2.967***	2.840***
(4) EBIT/INTEREST	-	5.39 (251)	10.06 (183)	-1.878*	-2.649***	-1.131
(5) LTDEBT/VALUE	+	0.18 (253)	0.19 (185)	-1.151	2.244**	-6.065***
(6) VALUE ($mil)	?	14840.8 (253)	7282.65 (185)	3.713***	3.113***	3.168***
(7) R&D/VALUE	+	0.017 (253)	0.0040 (185)	6.913***	1.538	7.714***
(8) BOOK/VALUE	-	0.68 (253)	0.68 (185)	-0.01	1.637	-3.016***
(9) CONVDEBT/VALUE	-	0.0084(253)	0.0059 (185)	1.096	0.221	0.613
(10) PFDSTK/VALUE	-	0.0071 (253)	0.0119 (185)	-2.433***	-1.284	-2.702***
(11) LIQUIDITY	-	1.46 (233)	1.67 (177)	-2.266**	-3.602***	-0.424
(12) DIVYIELD	+	0.026 (252)	0.033 (181)	-2.803***	-0.602	-3.156***
(13) FS/VALUE	+	0.1645 (253)	0.0519 (185)	8.196***	3.438***	9.988***
(14) EXPORT/VALUE	+	0.0206 (253)	0.0147 (185)	0.997	-0.386	1.452
(15) FXEXPOSURE	+	0.324 (245)	0.349 (178)	-0.818	-1.369	-2.087**
(16) IREXPOSURE	+	0.144 (245)	0.140 (178)	0.235	0.661	-0.932
(17) CREDITRAT	?	9.27 (225)	9.48 (141)	-0.550	0.217	-3.368***
(18) REGULATION	-	0.14 (253)	0.34 (185)	-4.684***	-3.090***	-7.213***

Variables are constructed as defined in the appendix. *, **, and *** indicate significant at the .10, .05, and .01 levels, respectively.

Table 4, Panel A
Results of Tobit Regressions explaining the use of Interest Rate and Foreign Exchange Derivatives

Variable (predicted sign)	Parameter estimates (P value)		
	NSS variables (403)	All variables (326)	VALUE and each separately
Constant	0.1104 (0.0117)**	0.0101 (0.8270)	NA
(1) TAXLOSSCF (+)	-0.000016 (0.5548)	-0.000024 (0.3115)	0.00004 (0.1587)
(2) ITC (+)	-0.0013 (0.1753)	-0.0005 (0.5578)	-0.0012 (0.1674)
(3) PROGRESSIVE (+)	0.0674 (0.0002)***	0.0332 (0.0512)	0.0734 (0.0001)***
(4) EBIT/INTEREST (-)	-0.0029 (0.0168)**	-0.0002 (0.8916)	-0.0026 (0.0050)***
(5) LTDEBT/VALUE (+)	0.0248 (0.8113)	0.1485 (0.1165)	0.0061 (0.9236)
(6) VALUE (?)	0.0015 (0.0212)**	0.0008 (0.1288)	0.00076 (0.0124)**
(7) R&D/VALUE (+)	1.6517 (0.0001)***	1.5626 (0.0002)***	1.5931 (0.0001)***
(8) BOOK/VALUE (-)	-0.0984 (0.1052)	-0.0225 (0.6874)	0.0215 (0.5913)
(9) CONVDEBT/VALUE(-)	-0.0661 (0.8357)	0.0589 (0.8291)	0.2359 (0.4532)
(10) PFDSTK/VALUE (-)	-0.6502 (0.117)	-0.6806 (0.0538)	-0.714 (0.0732)*
(11) LIQUIDITY (-)	-0.0413 (0.0045)***	-0.0487 (0.0013)***	-0.0245 (0.0404)**
(12) DIVYIELD (+)	-0.9750 (0.0262)**	-0.1860 (0.6437)	-1.235 (0.0018)***
(13) FS/VALUE (+)		0.1751 (0.0013)***	0.4345 (0.0001)***
(14) EXPORT/VALUE (+)		-0.1288 (0.3283)	0.0305 (0.8115)
(15) FXEXPOSURE (+)		-0.0222 (0.3471)	0.0215 (0.3892)
(16) IREXPOSURE (+)		-0.0261 (0.6849)	0.2338 (0.0001)***
(17) CREDITRAT (?)		0.0037 (0.2654)	0.0029 (0.1696)
(18) REGULATION (-)		-0.0448 (0.0549)*	-0.0700 (0.0006)
Log Likelihood for Normal	22.56	76.46	NA

NSS refers to regression results using only the variables used in Nance, Smith and Smithson (1993). Variables are defined in the appendix. * , **, and *** indicate significant at the .10, .05, and .01 levels, respectively.

Table 4, Panel B Results of Tobit Regressions explaining the use of Interest Rate Derivatives			
Variable (predicted sign)	Parameter estimates (P value)		
	NSS variables	All variables	VALUE and each separately
Constant	0.0478 (0.3020)	0.0098 (0.8474)	NA
(1) TAXLOSSCF (+)	-.00002 (0.6022)	-.0000004 (0.8714)	.000006 (0.8463)
(2) ITC (+)	-.0010 (0.3098)	-.0004 (0.6715)	-.0010 (0.2724)
(3) PROGRESSIVE (+)	.0519 (0.0054)*	.0236 (0.1883)	.0610 (0.0001)***
(4) EBIT/INTEREST (-)	-.0025 (0.0594)*	.00008 (0.9465)	-.0038 (0.0006)***
(5) LTDEBT/VALUE (+)	.1962 (0.0701)*	.2866 (0.0077)***	.1924 (0.0018)***
(6) VALUE (?)	.0009 (0.1742)	.0006 (0.3079)	.0006 (0.0246)**
(7) R&D/VALUE (+)	.7657 (0.0563)*	.7423 (0.0890)*	.2103 (0.5313)
(8) BOOK/VALUE (-)	-.1107 (0.0809)*	-.0490 (0.4018)	.0594 (0.1376)
(9) CONVDEBT/VALUE(-)	-.1069 (0.7638)	.1413 (0.6403)	.1604 (0.6208)
(10) PFDSTK/VALUE (-)	-.9736 (0.0376)**	-.7593 (0.0557)*	-.6216 (0.1381)
(11) LIQUIDITY (-)	-.0423 (0.0063)***	-.0631 (0.0003)***	-.0428 (0.0016)***
(12) DIVYIELD (+)	-.4743 (0.2909)	.3148 (0.4387)	-.4427 (0.2441)
(13) FS/VALUE (+)			
(14) EXPORT/VALUE (+)			
(15) FXEXPOSURE (+)			
(16) IREXPOSURE (+)		.0308 (0.6482)	.2406 (0.0001)***
(17) CREDITRAT (?)		.0009 (0.8091)	.0050 (0.0151)**
(18) REGULATION (-)		-.0740 (0.0025)***	-.0357 (0.0744)*
Log Likelihood for Normal	-29.428	9.468	NA

NSS refers to regression results using only the variables used in Nance, Smith and Smithson (1993). Variables are defined in the appendix. * , **, and *** indicate significant at the .10, .05, and .01 levels, respectively.

Table 4, Panel C Results of Tobit Regressions Explaining the Use of Foreign Exchange Derivatives			
Variable (predicted sign)	Parameter estimates (P value)		
	NSS variables n=403	All variables n=326	VALUE and each separately
Constant	0.0437 (0.0644)*	0.0074 (0.7979)	NA
(1) TAXLOSSCF (+)	-0.00001 (0.4389)	-0.000025 (0.0720)*	0.00003 (0.0441)
(2) ITC (+)	-0.0010 (0.0898)*	-0.0010 (0.24477)	-0.0008 (0.1669)
(3) PROGRESSIVE (+)	0.0375 (0.0001)***	0.0303 (0.0042)***	0.0352 (0.0005)***
(4) EBIT/INTEREST (-)	-0.0019 (0.0045)***	-0.0008 (0.3011)***	-0.0005 (0.2329)
(5) LTDEBT/VALUE (+)	-0.1723 (0.0045)***	-0.0653 (0.2848)	-0.2159 (0.0001)***
(6) VALUE (?)	0.0009 (0.0041)***	0.0003 (0.3340)	0.0005 (0.0084)***
(7) R&D/VALUE (+)	1.1423 (0.0001)***	0.9408 (0.0001)***	1.5822 (0.0001)
(8) BOOK/VALUE (-)	-0.0429 (0.1980)	-0.0090 (.8002)	-0.0436 (0.0953)*
(9) CONVDEBT/VALUE(-)	-0.0161 (0.9271)	0.0294 (0.8659)	0.1042 (0.6047)
(10) PFDSTK/VALUE (-)	0.0415 (0.8500)	0.0220 (0.9173)	-0.4190 (0.1057)
(11) LIQUIDITY (-)	-0.0144 (0.0684)*	-0.0144 (0.1183)	0.0009 (0.8951)
(12) DIVYIELD (+)	-0.50391 (0.0421)**	-0.3603 (0.1792)	-1.040 (0.0001)***
(13) FS/VALUE (+)		0.1777 (0.0001)***	0.2938 (0.0001)***
(14) EXPORT/VALUE (+)		-0.0473 (0.5666)	0.0927 (0.2471)
(15) FXEXPOSURE (+)		-0.0202 (0.2056)	-0.0170 (0.3285)
(16) IREXPOSURE (+)			
(17) CREDITRAT (?)		-0.0012 (0.5669)	-0.0031 (0.0562)*
(18) REGULATION (-)		-0.0103 (0.4962)	-0.0828 (0.0001)***
Log Likelihood for Normal	89.41	109.38	NA

NSS refers to regression results using only the variables used in Nance, Smith and Smithson (1993). Variables are defined in the appendix. * , **, and *** indicate significant at the .10, .05, and .01 levels, respectively.

Table 5
Summary of Results and Comparison with Nance, Smith, and Smithson (1993, NSS)

Variables (Predicted Sign)	Logit		Tobit		
	NSS n=169	Replication n=403	IRDERIV n=326	FXDERIV n=326	TOTDERIV n=326
Constant	NA	++			
(1) TAXLOSSCF (+)					
(2) ITC (+)	++				
(3) PROGRESSIVE (+)			+	++	++
(4) EBIT/INTEREST (-)		--	-		-
(5) LTDEBT/VALUE (+)			++	[-]	
(6) VALUE (?)	+	++	+	+	+
(7) R&D/VALUE (+)	+	++	+	++	++
(8) BOOK/VALUE (-)			-	-	
(9) CONVDEBT/VALUE(-)					
(10) PFDSTK/VALUE (-)		-	-		-
(11) LIQUIDITY (-)	-	--	--	-	--
(12) DIVYIELD (+)	++	--		[-]	[-]
(13) FS/VALUE (+)				++	++
(14) EXPORT/VALUE (+)					
(15) FXEXPOSURE (+)					
(16) IREXPOSURE (+)			+		+
(17) CREDITRAT (?)			+	-	
(18) REGULATION (-)			--	--	--

Variables are defined in the Appendix. NSS indicates results found in Nance, Smith, and Smithson (1993). ++, +, --, and - indicate the parameter estimate is positive and significant regardless of model specification reported in Table 4 (or in Table II in NSS), positive for some specifications, negative and significant regardless of model specification, and negative and significant in some models, respectively. [ ] indicates the sign of the coefficient is the opposite of the predicted sign.